Statement of Work
For the
Earth Science Data and Information System (ESDIS)
Maintenance & Development
(EMD)
Contract

RFI Version
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Section 1 – Introduction

This contract provides for the maintenance and enhancement of software and hardware systems that provide science data management for NASA's Earth Science Enterprise (ESE).

1.1 Background

NASA's Earth Science Enterprise seeks to develop a scientific understanding of the Earth system and its response to natural and human-induced changes to enable improved prediction of climate, weather, and natural hazards for present and future generations. The Enterprise has established three goals to pursued in carrying out this mission:

- **Science:** Observe, understand, and model the Earth system to learn how it is changing, and the consequences for life on Earth;
- **Applications:** Expand and accelerate the realization of economic and societal benefits from Earth science, information, and technology;
- **Technology:** Develop and adopt advanced technologies enable mission success and serve national priorities.

The vantage point of space provided by NASA led researchers to view the Earth as a dynamic system of land, atmosphere, oceans, ice and life, and gave birth to the interdisciplinary field of Earth System Science. This concept of the Earth as a system shaped the fundamental science questions the Enterprise seeks to answer:

How is the Earth changing, and what are the consequences for life on Earth?

- *How is the global Earth system changing?*
- *What are the primary causes of change in the Earth system?*
- *How does the Earth system respond to natural and human-induced changes?*
- *What are the consequences of change in the Earth system for human civilization?*
- *How well can we predict future changes in the Earth system?*

Earth science is science in the national interest, driving advances in weather forecasting, management of land and water resources, and agricultural productivity. Accordingly, the Earth Science Enterprise includes an applications research and demonstration program in parallel with its science program. Its areas of emphasis are:

- *Resource Management*, including forestry and agriculture;
- *Disaster Management*, including natural hazards ;
- *Community Growth*, including urban and transportation infrastructure; and
- *Environmental quality*. including land cover change.

The Earth Science Enterprise conducts it research in collaboration with a broad range of national and international science agencies. Nationally, these include individual US government agencies, a partnership of 11 federal agencies composing the US Global Change Research Program, and several focused interagency collaborations such as the US Weather Research Program. Internationally, these include the World Climate Research Program and the International Geosphere/Biosphere Program sponsored by such entities as the United Nations Environment Program and the World Meteorological Organization.

To answer the call for global scale observations sufficient to detect variability, trends, causes of change in the Earth system, the Earth Science Enterprise is deploying the Earth Observing System (EOS) of satellites. Four have already been launched and are operating: Landsat 7, QuikSCAT, ACRIMsat, and Terra, the EOS flagship mission carrying five different instruments. The balance of the EOS first series will be launched through 2003, including the multi-instrument Aqua and Aura missions, and the more focused Jason, ICEsat, SORCE and SAGE III missions. Complementing EOS are a series of small exploratory missions to measure Earth system forcings and responses, beginning in 2002, as well as a variety of suborbital platforms (e.g., aircraft and balloons) for *in situ* and remote sensing.

Data and information management system services are as essential as satellite observations to the success of the Earth Science Enterprise. Observing systems generate enormous quantities of data (over 1 terabyte per day) which must be acquired, processed, archived and distributed. Data acquired from satellites must be processed into globally consistent, calibrated, long-term data records. Diverse data sets must be combined to produce meaningful information on Earth system interactions. Data must assimilated into Earth system models. And these large volumes of data must be moved around, exchanged among researchers at geographically diverse institutions. Finally, data must broadly available—stored in ways that are not only accessible, but understandable to users from a variety of science and applications disciplines.

To perform these functions in the EOS era, the Enterprise has developed the EOS Data and Information System (EOSDIS). EOSDIS is being deployed in a series of releases timed to support the phased launches of major EOS missions. EOSDIS is currently operating and managing data from the EOS missions now in orbit, and preparing for the upcoming launch of Aqua. Subsequent releases will support Aura (2003) and other EOS missions leading up to it.

EOSDIS is a comprehensive data and information system designed to perform a wide variety of functions in support of a heterogeneous national and international user community. To this end, EOSDIS provides a spectrum of services including:

- Spacecraft command and control
- Data capture and telemetry processing
- Science data product generation
- Data archive management

- Search and order of science data
- Data distribution to a broad spectrum of users
- User support

EOSDIS is comprised of a variety of heterogeneous component systems that collectively perform the EOSDIS services in an integrated fashion. Central among these is the EOSDIS Core System (ECS) that provides the common capabilities and infrastructure of EOSDIS. Within ECS is the Science Data Processing Segment (SDPS), a key product that is the focus of this RFI.

The ECS SDPS:

• Generates science products from EOS observations,
• Accepts science products produced by Principal Investigators and International Partners, • accepts ancillary and supplementary data products for storage and distribution,
• Provides interfaces to instrument and interdisciplinary investigators' Science Computing Facilities (SCFs), which develop science data processing software and perform scientific research,
• Provides data archiving and distribution capabilities,
• Interfaces with the EOS Data Gateway for customer search and order of data.

ECS development is currently scheduled to be completed in October 2002. The ECS SDPS will continue to evolve within the framework of the New Data and Information Systems and Services (NewDISS). NewDISS refers to the distributed Earth science data systems and services, which, over the next 6 – 10 years, will evolve after the EOSDIS. NewDISS will consist of a heterogeneous mix of interdependent components derived from the contributions of numerous individual investigators and institutions. It is expected to be a flexible environment that can change readily to accommodate new technology and programmatic imperatives. The ECS SDPS will be an initial component of NewDISS and is expected to meet the NewDISS imperatives.

NASA began conceptual planning for NewDISS in the summer of 1998. The more heterogeneous processes and contributions for securing and providing data and information services called for in the NewDISS concept are expected to reduce the overall cost of providing Earth science data and information systems, and products and services, to the user community, a major goal for NASA Earth Science Enterprise.

A complete description of NASA's Earth Science Enterprise and Earth Observing System can be found at: http://www./earth.nasa.gov

Additional information can be found in the 1999 EOS Reference Handbook which can be found at:
http://eospso.gsfc.nasa.gov/eos_homepage/misc_html/refbook.html

The 1999 EOS Reference Handbook also contains a description of the 'EOS Data and Information System (EOSDIS)'.

See Attachment D of this statement of work for 'ECS Science System Sizing and Capacities Summary'.

Other informative Internet links can be found at the 'EMD RFI Home Page' at http://spso.gsfc.nasa.gov/emd/.

The Earth Science Data and Information System (ESDIS) Project, Code 423, at the Goddard Space Flight Center (GSFC) manages the EOSDIS on behalf of the ESE.

1.2 Objective

The contractor is a NASA team member (members include the ESDIS Project, the Distributed Active Archive Centers (DAACs), the science investigator teams, and the user community) whose goal is to reduce operational and maintenance cost, and improve the reliability, availability, functionality, operability, and performance of the science data processing system within the EOSDIS. Toward this goal the contractor may be tasked to:

- Provide corrective maintenance of the ECS custom and COTS software in a timely manner.
- Provide preventive and corrective maintenance of ECS hardware components consistent with the operational availability needs of ECS DAACs and science users.
- Provide hardware and software adaptive changes to sustain the ECS.
- Provide hardware and software perfective enhancements to implement new requirements.
- Provide corrective, adaptive, and perfective changes to lower the overall cost of maintenance and operations to the ESDIS Project
- Conduct engineering studies directed by the Government. These studies may include system analysis, planning, and recommendations in support of the NewDISS vision.

At a minimum, this contract provides for the maintenance and enhancement of the Science Data Processing System (SDPS) of the ECS. The ECS Mission Operations System (EMOS) and operation of the SDPS components of the ECS are specifically excluded from the scope of this contract. Science System interfaces to Mission System components are within scope.

The contractor's performance shall be consistent with the priorities and goals of the ESDIS Project (see section 2.1.5).

1.3 Scope

The scope of this contract includes all of the ESDIS Project Science Data Processing System. Specific work will be assigned by government via a task order.

The contractor shall provide all the necessary capabilities, including but not limited to trained personnel, tools, materials, documentation, procurement, software environments, hardware environments, and facilities, necessary to:

Manage the EMD program including program control, planning, reporting, reviews, procurement, and financial control

Transition the responsibility for ECS maintenance and development from the ECS contractor (NAS5-60000) to the EMD contractor.

Perform all hardware and software corrective, adaptive, and perfective maintenance and development activities required to support the ECS operational needs and to support new missions.

Perform ongoing system engineering functions in support of new requirements and improvement of the deployed system.

Support the science community interface to the ECS.

Support the ECS operations community.

Maintain the ECS system and all required security.

Perform property management services for the ECS system.

Maintenance and development of non-ECS science system components

1.4 Government Furnished Facilities, Equipment, and Services

The government will provide the following types of facilities, equipment, software, data, tools, and services. With the exception of DAAC facilities and science software, the following GFE is to be maintained, managed, adapted, modified, installed, operated, utilized, and enhanced by the EMD contractor after receipt.

- Final delivered ECS science system hardware installed, tested, verified and audited at the GSFC, EDC, LaRC, and NSIDC DAACs.
- Final delivered ECS science system custom and COTS software, installed, tested, verified, and audited at each of the four DAACs.
- Final science system documentation

  - DID 304 Segment Requirements Specification
  - DID 305 Segment Design Specification
  - DID 311 Database Design and Database
  - DID 313 ECS Internal ICDs
  - DID 333 ECS Toolkit
  - DID 411 Science Acceptance Test Procedures
  - DID 412 Science System Acceptance Test Report
  - DID 609 Operation Tool Manual
  - DID 611 Mission Operations Procedures
  - DID 625 Training Material
- ECS Verification Data Base (VDB)
- Office space, and telecommunications and administrative support at the DAACs for the on-site support staff at a similar level to the support provided to other, on-site contractors.
- TBD space at each DAAC for spare parts and components, test equipment, and repair work area.

The ECS contractor has developed systems, software, data, and tools in support of contract NAS5-60000. These systems, software, data, and tools can be made available to the EMD contractor in a 'as is' condition. The EMD contractor shall be responsible for all licenses and maintenance of these items. See Appendix E for a brief description of each item.

- Configuration Management Databases and related software
- ECS Development Facility (EDF)
- ECS Hardware and software system training
- Performance Verification Center (PVC)
- Property Management data base and related software
- Science product generation software
- Test Data
- Test Tools
- Verification and Acceptance Test Center (VATC),

1.5 Reference and applicable documents

1.5.1 Applicable Documents

- 423-41-02, ECS Functional &Performance Requirements Specification
- 423-10-23, EOSDIS Security Policy and Guidelines
- NPG2810.1, Security of Information Technology
- NPG4200.1 NASA Procedures and Guidelines Equipment Management Manual
- NASA Procedures and Guidelines (NPG) 4200.1E, Equipment Management Manual
- ECS External Interface Control Documents

(ESDIS Number and Short Name)

- 552-FDD-96/010R0UD0, ICD between ECS and AM-1 FDS
- 505-41-34, ICD between ECS and ASTER GDS
- 423-41-56, ICD between ECS and DAS
- 423-41-58, ICD between ECS and EDC
- 505-41-40, ICD between ECS and GSFC DAAC
- 586-1ICD/0398, ICD between ECS and LPDS
- 505-41-39, ICD between ECS and LaRC DAAC
- 505-41-32, ICD between ECS and Landsat 7
- 505-41-36, ICD between ECS and NOAA ADC
- 505-41-31, ICD between ECS and NSI
- 423-41-45, ICD between ECS and NSIDC DAAC
- 505-41-47, ICD between ECS and SAGE MOC III
- 505-41-33, ICD between ECS and SCFs
- 423-41-57-1, ICD between ECS and SIPS Volume 1 ACRIM III
- 423-41-57-2, ICD between ECS and SIPS Volume 2 SAGE III SCF Data Flows
- 423-41-57-3, ICD between ECS and SIPS Volume 3 ASTER OSF
- 423-41-57-4, ICD between ECS and SIPS Volume 4 ASTER DEM
- 423-41-57-5, ICD between ECS and SIPS Volume 5 MOPITT Data Flows
- 423-41-57-6, ICD between ECS and SIPS Volume 6 MODIS (MODAPS
- 423-41-57-7, ICD between ECS and SIPS Volume 7 AMSR-E
- 423-41-57, ICD between ECS and SIPS, Volume 0
- 505-41-30, ICD between ECS and Version 0
- 423-41-60 DFCD for EMOS ICC Planning and Scheduling
- 510-3FCD/0195 DFCB for Landsat 7 Processing System Output Files
- 430-11-06-007-3 DFCB for Landsat Zero-R Distribution Products, Volume 5 Book 1
- 423-16-01 Data Production Software and SCF Standards and Guidelines
- 510-ICD-EDOS/EGS ICD between EDOS and EGS
- 423-41-63 ICD between EMOS and SDPS
- TBD # FDS-DAACs-Aqua ICD between FDS and DAACs for Aqua
- 430-15-01-002-2 Landsat 7 System Calibration Parameter File Definition Document
- 430-11-06-009 ICD between Landsat 7 and IGS
- 423-42-06 EDG Message Protocol
- 423-41-57-XXX ICD between ECS and SIPS Volume XXX MLS (to be baselined)
- 423-41-57-XXX ICD between ECS and SIPS Volume XXX TES (to be baselined)
- 423-41-57-XXX ICD between ECS and SIPS Volume XXX HRDLS (to be baselined)
- 423-41-57-XXX ICD between ECS and SIPS Volume XXX OMI (to be baselined)

- 423-41-57-XXX ICD between ECS and SIPS Volume XXX GLAS (to be baselined)
- 540-032 ICD between EBnet and DAACs
- 540-036 ICD between EBnet and SMC

1.5.2 Reference Documents

- 423-10-02 ESDIS Project Plan
- ANSI/ASQC Q9001

1.6 Definitions

Corrective Maintenance – Changes necessitated by actual errors (i.e. 'bugs'), or design deficiencies. Corrective maintenance consists of activities normally considered to be error correction required to keep the system operational. By its nature, corrective maintenance is usually a reactive process. Corrective maintenance is related to the system not performing as originally intended. The three main causes of corrective maintenance are (1) design errors, (2) logic errors, and (3) coding errors.

Adaptive Maintenance – Changes initiated as a result of changes in the environment in which a system must operate. These environmental changes are normally beyond the control of the maintainer and consist primarily of changes to the: (1) rule, laws, and regulations that affect the system: (2) hardware configuration, e.g., new terminals, local printers, etc.: (3) data formats, file structures: and (4) system software, e.g., operating systems, compilers, utilities, etc.

Perfective Maintenance – (Also known as enhancements) All changes, insertions, deletions, modifications, extension, and enhancements made to a system to meet the evolving and/or expanding needs of the user. It is generally performed as a result of new or changing requirements, or in an attempt to augment or fine-tune the existing software/ hardware operations/performance. Activities designed to make the code easier to understand and to work with, such as restructuring or documentation updates and optimization of code to make it run faster or use storage more efficiently are also included in the Perfective category.

Preventive Maintenance – As used in this statement of work refers to hardware preemptive activities, such as cleaning filters and installing recommended engineering changes, to avoid future failures.

1.7 Place of Performance

The contractor is responsible for selecting the location(s) to perform the activities required by this statement of work. The selected location(s) shall be consistent with the need to be fully responsive to the contract administration, management, and technical interfaces with the ESDIS Project located at the Goddard Space Flight Center in Greenbelt, Maryland. The contractor will also need to interface with the DAACs and their customers.

The selected performance locations shall consider travel time (contractor's and government's), frequency, and criticality. Also to be considered is the appropriateness of the interface method (e.g. telephone, email, videoconference, and face to face) to the interface activity.

The contractor's facility shall be able to accommodate government and government support personnel attending required monthly reviews. This includes, but is not limited to conference rooms and video conferencing capabilities.

The contractor shall make TBD office space available for government, government support personnel, and government assurance representatives upon request. (Note: The office space required may be dependent of the offeror' s approach and geographic location. The TBD will be definitized prior to contract award.)

Section 2 – Work to be Performed

2.1 Program Management

The contractor shall direct and integrate the program management activities necessary to ensure the successful performance of this contract.

2.1.1 Program Control

The contractor shall establish a management organization with the necessary capability and authority to ensure that contract, technical, schedule, and cost requirements are met. The prime contractor is fully responsible for the management and performance of its subcontractors and vendors.

The contractor's primary interface is with the ESDIS Project. Contract direction and modification can be provided only by the government Contracting Officer (CO). Technical Direction can only be provided by the government Contracting Officer's Technical Representative (COTR).

The contractor shall supply all the necessary support tools to manage this contract.

The contractor shall establish a formal risk management process that includes risk assessment and risk control. Risks shall be reviewed regularly with the ESDIS Project.

2.1.2 Program Planning, Reporting, and Reviews

<u>Planning</u>

The contractor is responsible for all planning necessary to accomplish the work defined by this SOW.

The contractor shall identify, document, and deliver all management plans to the government for comment and where applicable, approval.

<u>Reporting</u>

The contractor shall formally report technical, schedule, and financial performance on a monthly basis. The contractor shall report to ESDIS Project whenever the contractor's performance warrants communication of current

status more often than monthly. The contractor shall submit written reports and orally present status at monthly and other progress reviews.

In addition to formal presentations, the contractor shall meet with ESDIS Project technical monitors on a weekly (or other mutually agreed to) basis to communicate status and priorities.

Reviews

The contractor shall conduct programmatic and technical reviews with the ESDIS Project to ensure the clear communication of the contractors methodologies and priorities to the government. The ESDIS Project will attend these reviews to ensure the contractor's and NASA's goals are in alignment. The ESDIS project may also include DAAC and science community members, and members of the ECS IV&V team as part of these reviews.

At a minimum, the contractor shall conduct the following technical reviews:

- Consent to Ship Review (CSR)
- Pre-Ship Review (PSR)
- Site Readiness Assessment (SRA)
- Release Status Review (RSR)

Table 2.1.2 defines the above reviews.

Table 2.1.2 Technical Review Description

Review	Review Description
CSR	CSRs will be conducted for any software release containing major new functionality. The review will address the readiness of the release for delivery to the operational sites for testing. The review shall include: • functionality, regression and end-to-end performance test results, • results of test installations in the development facility, • software and hardware PCA results, • a summary of and an operations impact assessment of any liens against the release, and • a summary of documentation available for the release. The ESDIS project will determine whether the release is ready for shipment to the DAACs based on the review.
PSR	PSRs will be conducted for any software release or patch, including patches and upgrades to COTS software. The review shall include: • new functionality, regression and installation test results conducted for the release or patch, • a detailed walkthrough of the installation instructions for the release or patch, and • a description of and operations impact assessment of any liens against the release. The primary audience for the review shall be the DAAC staffs.
SRA	For software releases containing major new functionality, SRAs will be held for each operational site to review the results of site release testing and to determine whether the release is ready for transition to operations. The review will include: • results of on-site testing, • a description of existing liens against system functionality and work-off plans, especially liens discovered as part of on-site testing, • a description of installation problems encountered at the site, and • plans for incorporating lessons learned from site testing and installation results into future release support.
RSR	RSRs will be conducted yearly, unless a CSR has been conducted in the 12 months prior to the review. The review will address the on-going acceptability of the current release baseline. The review shall include: • any acceptance test results for tests conducted in the last year, • end-to-end performance test results, • software and hardware PCA results, • a summary of any liens against the release baseline and an operations impact assessment of these liens, and • a summary of documentation available for the release baseline.

2.1.3 Financial Management

The contractor shall submit NASA Financial Management Reports 533M and 533Q as required by the NASA Contractor Financial Management Reporting clause of this contract.

2.1.4 Procurement Management

The contractor shall prepare a Procurement Management Plan (DID # PMP) which will document procedures to be used for the competitive selection and procurement of required products and services, as well as the management of vendors and subcontractors.

2.1.5 Performance Based Metrics

The contractor shall identify, implement, track, and analyze a comprehensive set of metrics over the period of the contract. Metrics shall address all performance aspects of this SOW.

The metrics shall be designed to measure the attainment of NASA's goals in quantifiable terms. Each metric shall have clear, quantifiable performance thresholds. The metrics may be used to assess the contractor's performance during the award/incentive fee (or award term) process.

2.1.6 Contractor/Government Priority Board

The contractor shall reflect the overall goals and priorities of the ESDIS Project when establishing internal work priorities and recommending enhancements and modifications. The priorities and goals of the ESDIS Project consider the net benefit to the ESDIS Project and user community. Examples are provided in Table 2.1.6.

The contractor shall participate in a joint government/contractor priority board to establish consensus priorities for specific work performed under this contract. The priority board shall address corrective, adaptive, and perfective modification requests. The government's primary role in the joint board is to communicate NASA's priorities and changes of priorities. If the joint priority board cannot reach consensus as to the classification (I.e. corrective, adaptive, or perfective) of a change, the COTR will make the final determination. Work shall proceed immediately based on the COTR's determination.

Table 2.1.6 – Examples of ESDIS Priorities and Goals

Work Element	Goals
Software Maintenance	
Bug Fixes	Fix the most mission critical bugs first, followed by those having the greatest operations impact (including stability) followed by others.

Work Element	Goals
Software Reengineering	Re-engineer, replace or eliminate software components to decrease overall system maintenance and operations costs, improve system reliability, replace software performance features with hardware performance or capacity, replace OTS SW components with custom components or vice versa, and re-use SW components from other efforts.
Software Quality Enhancements	Enhance design and code documentation, code structure, and language usage to decrease overall maintenance costs.
OTS Upgrade Support	Modify software to support new OTS SW and HW elements and versions, including security patches, to minimize system problems due to out of date versions.
Security Upgrades	Modify software to enhance security of the system and correct security weaknesses.
Routine Enhancements	Modify software to increase overall system usability and operability, or to enhance system interfaces to better support integration with other components and systems.
Operations Support Tools	Develop operations support tools that increase system operability, perhaps reducing operations demands or supporting greater overall system throughput by allowing the same size operations staff to support additional tasks.
Performance Enhancements	Modify existing software components or add new components to support additional system performance requirements (e.g., support additional processing or distribution load) based on mission timelines.
New Functionality	Add new functionality as required based on mission timelines.
OTS SW Maintenance	
Version Upgrades	Perform OTS SW upgrades to avoid loss of OTS support or to address OTS deficiencies, including security issues, so that system availability is maximized.
Replacement	Replace obsolete OTS SW to decrease overall maintenance costs.
Baseline Extension	Add OTS SW components to the software baseline as required for new functionality, tools or external interfaces, or to provide additional available from capabilities from new OTS SW components.
Hardware Maintenance	
Version Upgrades	Perform OTS HW upgrades to avoid loss of OTS support or to address OTS deficiencies so that system availability is maximized.
Replacement	Replace obsolete OTS HW to decrease overall maintenance costs.
Capacity Upgrades	Add HW capacity to the system to address new performance or mission requirements.

2.1.7 Quality Management System

The Contractor shall have a Quality Management System (QMS) that is compliant with ANSI/ASQC Q9001. The QMS will be applied to all maintenance and development activities related to the performance of this contract. The Contractor shall provide a Quality Manual of their QMS procedures and guidelines in accordance with the contract delivery schedule. In all cases, the maintenance and development effort shall provide evidence (quality records accessible for GSFC review) as insight to the quality of the software and/or

hardware baseline system. The developer's QMS representatives shall maintain open communications with the GSFC quality representatives for the Project.

2.2 Transition of ECS Maintenance & Development Responsibilities

The contractor shall develop and implement a transition plan to fully prepare for and accept the transfer of hardware and software maintenance and development responsibilities from the ECS development contractor. The contractor shall also plan for the transfer of development system, configuration control systems, tools, and documentation. The Transition Plan (DID # TP) shall include at a minimum:

- General responsibilities, objectives, and phases
- Requirements (software, hardware, tools, documentation)
- Execution of COTS Software license agreements for existing COTS software
- Installation and testing (tests and schedules)
- Training of maintenance personnel
- Other Transition Requirements: facilities, personnel, and other resources
- Schedule milestones
- Required government furnished equipment, material, and resources
- Property Management

The contractor shall coordinate all transition activities with the ECS development contractor and the ESDIS Project. The contractor is fully responsible for ensuring a smooth transition of responsibilities and no impacts to the operational readiness of ECS. The contractor shall fully complete transition of responsibilities no later than October 1, 2002.

Transition activities shall include, but not be limited to, work necessary to ensure the ECS hardware and software systems, documentation, and other data (e.g. test data) are maintainable per the contractor’s software and hardware maintenance plans discussed elsewhere in this SOW.

The transition period shall be completed with a demonstration of the capability to develop, deliver and test new releases/patches into an operational environment. COTS licensing and maintenance arrangements for software and hardware shall be in place at the time of transition.

At the end of the transition phase the contractor shall conduct a performance test. The detailed definition of the test shall be approved by the ESDIS project prior to its execution. Members of the ESDIS project or their designated representatives must witness the test. The performance test shall demonstrate that the contractor is ready to successfully support release development, installation and testing. The test shall include the following elements:

- generation of a complete release using the contractor’s development tools,

- regression testing of the release to verify that fundamental functionality is still working properly and that the contractor is capable of rapidly regression testing new releases and patches,
- a full system installation into a simulated operational environment at the development facility that must be completed in less than 2 days, and
- end-to-end performance testing at the development facility that approximates the 24-hour DAAC operations loads for the GSFC and EDC DAACs in the 1/03 timeframe.

Transition activities shall include the full transfer of responsibility for property management (Section 2.9, Property Management).

2.3 System Maintenance & Development

2.3.1 General

The contractor is responsible for the total hardware and software maintenance and development process including, but not limited to, management, design, implementation, modification, configuration management, personnel training, operator training for baseline changes, integration, installation, user liaison, help desk, testing, quality assurance, and technical assistance. The contractor is also responsible for the maintenance of system documentation, including but not limited to design documentation, operations procedures, and user's guides. The contractor shall plan, document, implement, and maintain the hardware and software maintenance and development process to be used throughout the life of the ECS maintenance program.

The contractor shall ensure that hardware /software maintenance and development activities do not degrade, impair, delete, or otherwise reduce the functionality or performance of the current operational system. See ECS Functional and Performance Specification, SOW Section 1.5 Applicable and Reference Documents.

The contractor shall replace, delete and/or upgrade custom software, COTS software, and COTS hardware based on favorable cost trades against the overall ESDIS maintenance and operations costs, or to improve system performance, maintainability, and/or reliability.

The contractor shall ensure the compatibility of interfaces between the ECS and other system components.

The contractor shall maintain ECS documentation. Documentation to be maintained shall include government furnish documentation (see section 1.4) and documentation generated by the contractor for maintenance and/or new implementations.

The contractor shall implement, maintain, and manage a software and hardware problem reporting system.

The contractor shall provide a 'help desk' function such that the operational DAAC sites have a means of contacting the EMD contractor 24 hours a day, 7 days a week to receive immediate assistance for emergency operational problems with the hardware and software systems.

The contractor shall be readily accessible to the operational DAACs on a 5-day per week, 8-hour per day basis to answer routine questions, provide status of corrective changes, support new patches and releases, and coordinate future deliveries.

The contractor shall develop and document detailed working agreements with the DAACs and other organizations that interact with the EMD organization. The contractor shall clearly document and communicate maintenance interfaces and processes to the DAACs and ESDIS Project, and coordinate maintenance schedules with the DAACs.

The contractor shall provide the necessary hardware and software maintenance environment to perform maintenance and enhancement functions required by this statement of work. The maintenance environment may consist of the GFE maintenance environment and/or new components and tools. The maintenance environment shall be maintained throughout the contract period of performance.

All new functionality shall be acceptance tested prior to its release to the DAACs. The acceptance tests to be used shall be approved by the ESDIS project.

End-to-end performance tests with loads equivalent to 24 hours of DAAC operations shall be executed for each major software release or at least yearly (if no releases have occurred in the 12 months prior to the test). These tests shall approximate the maximum loads projected to occur during the year following the test dates. The exact workloads to be used for each test shall be defined jointly by the EMD contractor and NASA, and approved by the ESDIS Project. These tests shall be executed in the contractor's maintenance facility.

Regression testing consisting of an ESDIS-approved set of functionality tests shall be executed as part of the testing for each major release or patch prior to its release to the DAACs.

Installation testing consisting of full trial installations and installation 'back-outs' from a simulated operational environment shall be executed prior to the shipment of each major release or patch to the DAACs. Installation tests shall also include execution of regression tests once the installation is complete to verify that the installation functions properly. The installation test should

demonstrate that the installation and transition to operations for the release or patch could be completed in less than 24 hours.

A member of the ESDIS project or their appointed representative must witness the execution of all acceptance, regression, installation and performance tests.

The contractor shall maintain and operate the Systems Management Center (SMC) located at Goddard Space Flight Center. The SMC provides a central site for software release distribution to the DAACs and collection of ECS Trouble Tickets/problem reports from the DAACs. The SMC also maintains the ECS Network configuration and the DAAC operations knowledge base.

The contractor shall ensure the security of the ECS and data holdings throughout the period of performance of this contract. See Section 3.8.

The contractor shall implement, maintain, and manage an ECS modification request process. The contractor shall accept Modification Requests (MR) submitted from the ESDIS Project, the DAACs, and the user community, as well as from the maintenance contractor. Modification requests may include requests for corrective, adaptive, and perfective changes. All MRs shall be reviewed, approved, and prioritized for implementation by a control board function. The system users (i.e. DAACs or their ESDIS representative) shall participate in the prioritization process for corrective changes. A conceptual process flow is illustrated in Figure 2.3.

Whereas perfective changes may require funding approval, an ESDIS Project representative shall participate in the contractors control board function. Formal authorization for perfective changes will be provided via the task order process.

In addition to responding to corrective, adaptive, and perfective modification requests, the contractor shall continuously analyze the ECS hardware and software system to identify implementation and architecture changes that may reduce the overall maintenance and operational cost to the ESDIS Project. Recommended changes shall be submitted as MRs for consideration.

2.3.2 Software

The contractor shall be fully responsible for the software maintenance of the ECS. This responsibility includes, but is not limited to, ECS custom code and scripts, COTS software products, Earth Science Data Types (ESDTs), databases, configuration control, documentation, testing, reviews, and support services. The contractor shall not make any assumptions about the responsibilities of other organizations relative to the maintenance and development of the ECS.

A Software Maintenance and Development Plan (DID #SMDP) shall be submitted to the government for initial concurrence. The contractor shall maintain the plan and procedures by a formal change control process. The SMDP shall address methodologies for corrective, adaptive, and perfective changes. The SMDP shall include, but not be limited to:

- Contractor's maintenance and development concept (including use of vendors)
- Organization and maintenance activities
- Resources
- Processes
- Testing and verification
-Training requirements
- Maintenance/development records and reports

The contractor's interface to the DAACs shall include a Patch Integrated Product Team (IPT) to convey and prioritize DAAC problems and for describing upcoming emergency patches. Pre-Ship Reviews (PSRs) shall be conducted for COTS changes (hardware and software) and roll-up patches. A Consent to Ship Review (CSR) shall be conducted for each major release.
Software metrics (see section 2.1.4) shall include, but shall not be limited to:

- Software size
- Software staffing
- Maintenance Request processing
- Software enhancement scheduling
- Computer resource utilization
- Fault density
- Software volatility
- Discrepancy report open duration
- Break/fix ratio
- Software reliability
- Design complexity
- Fault type distribution

2.3.3 Hardware

The Contractor shall provide preventive and corrective maintenance of the ECS computer equipment including, but not limited to, central processing units, workstations and servers, direct access storage devices, robotic tape libraries and tape devices, laser printers, network and communications devices, and other associated equipment for the ECS System**.** Equipment is located at the 4 DAAC sites, the SMC, and the contractor's maintenance and development facility.

The contractor shall maintain the hardware in accordance with OEM standards for maintenance, including installation of OEM recommended microcode and engineering changes. The contractor shall maintain the equipment in such a manner that it is certified to be acceptable by the OEM for maintenance.

The contractor shall enhance ECS hardware, if required, to support software upgrade.

A Hardware Maintenance and Development Plan (DID #HMDP) shall be submitted to the government for initial concurrence. The contractor shall maintain the plan and procedures by a formal change control process. The HMDP shall address methodologies for corrective, adaptive, and perfective changes. The HMDP shall include, but not be limited to:

- Contractor's maintenance and development concept (including use of vendors)
- Organization and maintenance activities
- Resources
- Processes
- Testing and verification
- Training requirements
- Maintenance/development records and reports

The contractor shall perform preventive maintenance as necessary to ensure the ECS reliability and operational availability requirements are achieved. See the ECS Functional and Performance Specification.

The contractor shall ensure that all failed hardware components are restored to service in a time period consistent with the operational availability requirements of the ECS.

Hardware maintenance shall be provided for equipment transitioned to the contractor, equipment upgrades, enhancements performed by the contractor, capacity upgrades, and for specific equipment provided by the government.

The contractor shall be responsible for the timely repair of all hardware components regardless of the cause of failure. In the event an equipment failure is caused by events beyond normal wear and tear (e.g. due to the negligence of the government or the operations staff, or catastrophic event), the contractor may submit a request for equitable adjustment.

The contractor shall maintain records of equipment failures, repair statistics, Engineering Changes (ECs), trend analysis, time to restore, etc. Maintenance records shall be made available to the government upon request.

Hardware maintenance shall include the maintenance of hardware component microcode.

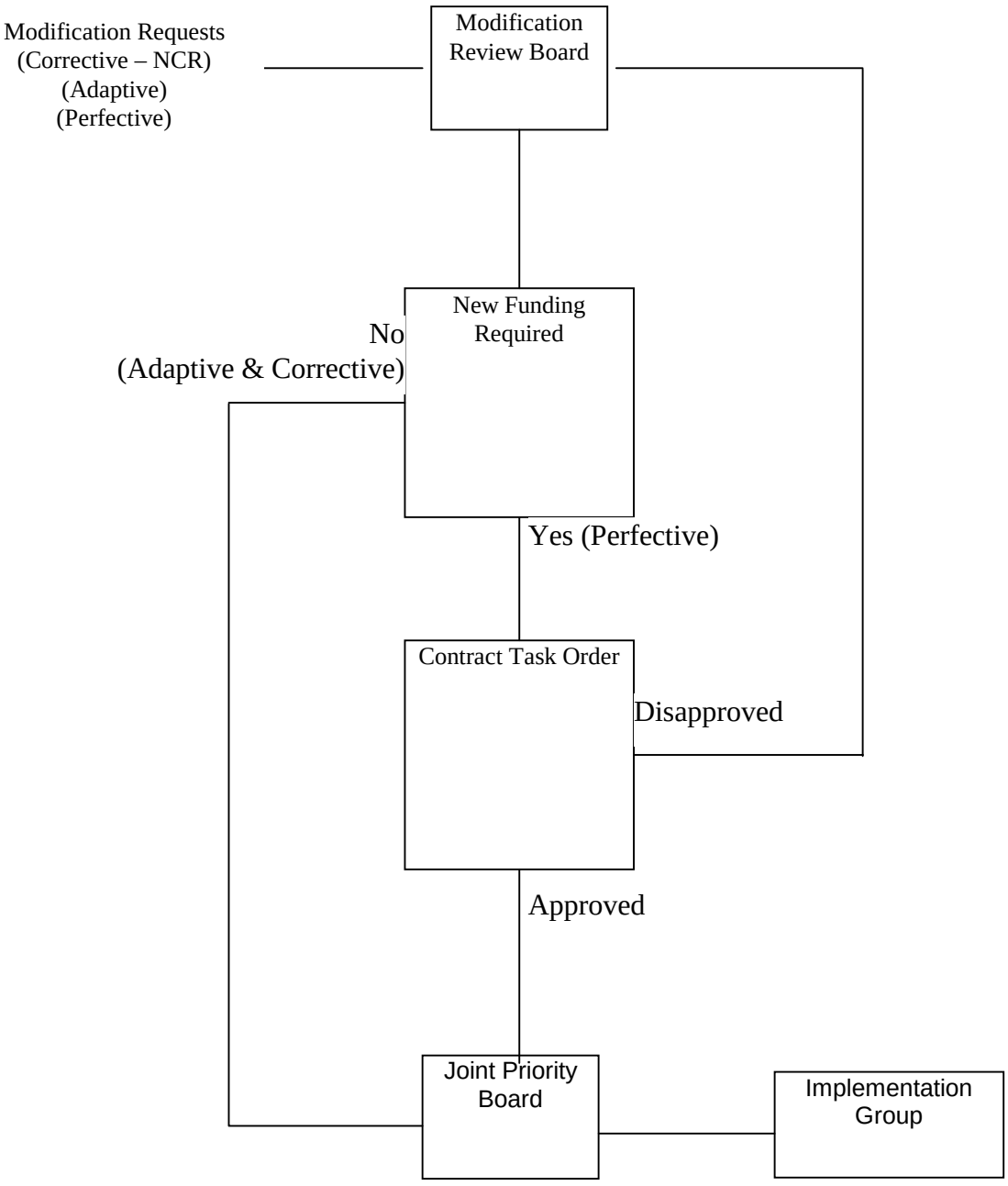


Figure 2.3 – Conceptual Modification Request Process

2.4 System Engineering and Enhancements

The contractor shall submit System Enhancement Proposals (SEP), on an as needed basis, describing proposed upgrades, enhancements, architecture and design improvements, and technology refreshment. Upgrades shall include system capacity increases to support on-going missions. The SEP shall identify recommended changes to ECS hardware and software systems along with detailed rationale for the changes. It shall include schedules, transition plans, and total system life costs for procurement, development, integration, test, and maintenance. Specific upgrades and enhancements are approved and authorized by the government via task order. The SEP and tasks shall be an integrated part of the MR process.

New system functional and performance requirements may be initiated by the ESDIS Project to provide government sponsored enhancements and/or to support new missions. New system requirements will be initiated through the MR process. The contractor shall provide system engineering support for analysis of new requirements, recommended technical approaches, schedules, and resource estimates. The CO will provide the authority to proceed and the contractor shall not proceed without such authority.

The contractor shall conduct ongoing risk management program including risk mitigation plans.

The contractor shall provide configuration control of ECS hardware and software.

The contractor shall support the management of ECS requirements. The ECS Functional and Performance Specification is configuration controlled at the ESDIS Configuration Control Board. The contractor shall control lower level requirements at the contractors configuration control board.

Although the ESDIS project is responsible for overall EOSDIS integration, the contractor shall support these integration activities as follows:

- by supporting pre-release interface tests from the development facility,
- by reviewing EOSDIS integration test specifications, and
- by providing on-site assistance in identifying problem causes and recommending possible fixes

2.5 Science Support

The contractor shall provide support to the science community as follows:

- Update Earth Science Data Types (ESDTs) and associated services to support evolving science products based on periodic inputs from the Instrument Teams (ITs).

- Work with ITs to define and develop new ESDTs to support new product types.

- Provide ESDT training to ITs including instruction on the EOSDIS data model, the ESDT definition process, and the metadata requirements and options.

- Support the development and maintenance of the interface documentation between ECS and each of the supported ITs.

- Assist the ITs in the development of their Quality Assessment Plans.

- Work with the ITs and their associated Science Teams to evaluate and refine any requested modifications or extensions to the ECS in support of the for mal Modification Request process.

- Assist DAACs in analyzing and resolving Product Generation Executive (PGE) system interface problems.

2.6 Operations Support

The contractor shall provide operations support as follows:

- Train operations personnel in how to operate the evolving system.

- Train operations personnel in the installation of and transition to major system upgrades, including major COTS upgrades.

- Provide on-site support at the four DAACs for the installation of and transition to major system upgrades.

- Provide CM support for externally developed Operational Support Software (OSS) components. OSS components are operational tools developed and maintained externally (e.g. by the DAAC operation's staff).

- Provide tools and support to minimize the impact of each new patch or release to on-going operations. The installation and transition to operations of each release or patch shall be able to be completed in less than 24 hours.

- Assist DAACs with on-site problem diagnosis, including security issues, and system tuning to ensure system down time is minimized and to ensure mission support is maximized.

2.7 Performance Assurance

The Contractor shall provide efforts and resources necessary to ensure that system wide standards and controls are in effect and are followed throughout all maintenance and development efforts. The Contractor shall establish a Performance Assurance Program and ensure that the same performance assurance requirements flow down to the subcontractors.

The work activities, operations, and documentation efforts performed under this contract by the contractor, subcontractors, or suppliers at all locations are subject to evaluation, review, survey, and inspection by Government designated representatives from the GSFC, the Government Inspection Agency (GIA), or an independent assurance contractor (IAC). GSFC will delegate specific in-plant responsibilities and authority to those agencies in a letter of delegation or in the GSFC contract with the IAC.

The Contractor, upon request, shall provide the Government assurance representatives with documents, records, and information required to perform government assurance activities.

2.7.1 Software Assurance

The Contractor shall plan and implement a Software Assurance Program in accordance with the Contractor's Quality Management System (QMS). The Contractor shall establish, as a minimum, standards and procedures for software and project documentation, coding standards, configuration management, discrepancy reporting, and peer reviews.

The Software Assurance Program shall address all phases of the software development lifecycle to assess the maturity of the software and operational system and the contractor's compliance to plans and procedures. The Contractor's Software Assurance Program shall include participation in design reviews, software inspections, configuration control boards, programmatic and technical reviews, risk management, quality assurance audits (e.g., configuration management audits), as well as any other activities necessary to insure the overall performance of the development activity and operational system. The Contractor shall provide an EMD Quality Assurance Plan (QAP) documenting the roles and responsibilities, surveillance activities, and nonconformance reporting processes of the QA organization. QA shall document the results of their software assurance activities and upcoming events in a monthly status report.

2.7.2 Hardware Assurance

The Contractor shall conduct a hardware Reliability, Maintainability, and Availability (RMA) program oriented toward analyzing engineering design tradeoffs of COTS hardware as it relates to adaptive and perfective enhancements to the ECS operational system. The objective shall be to maintain an operational system that (a) stays within previously specified maximum down time requirements, (b) meets specified availability requirements (per the ECS F&PRS) for the system and its functions, and (c) optimizes reliability and maintainability tradeoffs to maximize ECS system performance. Any changes to the hardware system baseline shall not degrade, impair, delete, or otherwise reduce the functionality or performance of the current operational system. RMA data shall be maintained in a common-use database accessible for logistics analyses and other purposes.

2.7.2.1 Reliability Activities

Reliability activities shall include but not be limited to the following tasks:

- Reliability allocations
- Reliability predictions
- Failure mode effects and criticality analysis (for potential critical and catastrophic failures relating to data throughput and distribution)
- Reliability evaluations

2.7.2.2 Maintainability Activities

The Contractor shall manage the maintainability requirements for the system, review and assess the design and specifications for adherence to the maintainability requirements, prepare Mean Down Time (MDT) predictions for changes to functional threads, and review requirements for maintainability verification. Given the operational status of ECS, the Contractor shall periodically verify that the system continues to meet the maintainability specifications contained in the ECS F&PRS.

2.8 Security

The contractor shall implement and maintain a security program for the ECS system and data consistent with 423-10-23, EOSDIS Security Policy and Guidelines Document, and NPG 2810.1, Security of Information Technology (see Section 1.5, Applicable and Reference Documents).

The contractor shall maintain and upgrade the security features of the ECS hardware and software components to ensure the integrity of the system and the protection of the data holdings.

2.9 Property Management

The Contractor shall provide property management services in support of the ECS System at the ECS DAACs, SMC, and the contractors maintenance and development facility. The Contractor shall provide all labor, supervision, tools, materials, parts, equipment, and transportation necessary to provide these services.

The Contractor shall prepare a Property Management Plan in accordance with DID #PMP and the NASA Procedures and Guidelines (NPG) 4200.1E, Equipment Management Manual. The Property Management Plan provides for the control of Contractor and Government property and for a continuous audit trail from receipt of an item until final transfer of accountability or disposal. The Contractor shall have property management responsibility for ECS and government property assigned to the Contractor until it has been accepted by the CO/COTR or transferred to another contractor.

This requirement includes, but is not limited to:

a. Establishing and maintaining records of property

b. Tagging ECS computer equipment

c. Reporting untagged controlled equipment to the NASA Property Administrator

c. Assisting the Government representatives in the physical inventory of controlled equipment

d. Preparing and distributing monthly transaction reports and quarterly property inventory report

e. Preparing required forms when property is transferred, shipped, modified, or disposed of

f. Identifying and reporting equipment that is no longer needed

g. Continuing surveillance to ensure that equipment is properly used and physically protected

h. Training contractor personnel on their property responsibilities and obligations

Attachments

Attachment A

EMD Acronym List

ACRIM	Active Cavity Radiometer Irradiance Monitor
ADC	Affiliated Data Center
AMSR-E	Advanced Microwave Scanning Radiometer
ASTER	Advanced Spaceborne Thermal Emissions and Reflection Radiometer
CO	Contracting Officer
COTR	Contracting Officer's Technical Representative
COTS	Commercial Off The Shelf
CSR	Consent to Ship Review
DAAC	Distributed Active Archive Center
DAS	Data Assimilation System
DBMS	Data Base Management System
DCE	Distributed Computing Environment
DDTS	Distributed Defect Tracking System
DID	Data Item Description
EbNet	EOSDIS Backbone Network
EC	Engineering Change
ECS	EOSDIS Core System
EDC	EROS Data Center
EDF	ECS Development Facility
EDOS	EOS Data and Operations System
EGS	EOS Ground System
EMD	ESDIS Maintenance and Development
EMOS	EOS Mission Operations System
EOC	EOS Operations Center
EOS	Earth Observing System
EOSDIS	Earth Observing System Data and Information System
EROS	Earth Resources Observation System
ESDIS	Earth Science Data and Information System
ESDT	Earth Science Data Type
ESE	Earth Science Enterprise
FDS	Flight Dynamics System
F&PRS	Functional and Performance Requirements Specification

GDS	Ground Data System
GFE	Government Furnished Equipment
GIA	Government Inspection Agency
GLAS	Geoscience Laser Altimeter System
GSFC	Goddard Space Flight Center
HMDP	Hardware Maintenance and Development Plan
HW	Hardware
HIRDLS	High-Resolution Imaging Spectrometer
IAC	Independent Assurance Contractor
ICD	Interface Control Document
IGS	International Ground Station
IPT	Integrated Product Team
IT	Instrument Team
IV&V	Independent Verification and Validation
LaRC	Langley Research Center
LPDS	Level 1 Product Distribution System
MDT	Mean Down Time
MLS	Microwave Limb Sounder
MODIS	Moderate Resolution Imaging SpectroRadiometer
MOPITT	Measurement of Pollution In The Troposphere
MR	Modification Request
NASA	National Aeronautic and Space Administration
NCR	Non Conformance Report
NewDISS	New Data and Information Systems and Services
NOAA	National Oceanic and Atmospheric Administration
NPG	NASA Procedure and Guideline
NSI	NASA Science Internet
NSIDC	National Snow and Ice Data Center
OEM	Original Equipment Manufacturer
OMI	Ozone Monitoring Instrument
OSF	Open Software Foundation
OSS	Operations Software Support
OTS	Off the Shelf
PGE	Product Generation Executive
PMP	Procurement Management Plan
PSR	Pre Ship Review
PVC	Performance Verification Center
QMS	Quality Management System

RFI	Request For Information
RMA	Reliability, Maintainability, and Availability
RSR	Release Status Review
SAGE III	Stratospheric Aerosols and Gas Experiment III
SCF	Science Computing Facility
SDPS	Science Data Processing System
SEP	System Enhancement Proposal
SIPS	Science Investigator-Led Processing Systems
SMC	System Management Center
SMDP	Software Maintenance and Development Plan
SOW	Statement of Work
SRA	Site Readiness Review
SW	Software
TES	Tropospheric Emissions Spectrometer
TBD	To Be Determined
VATC	Verification and Acceptance Test Center
VDB	Verification Data Base

Attachment B

EMD Task Order – ECS Maintenance & System Engineering

Attachment B is a draft of the anticipated minimum task to be issued under this contract.

Within the scope of this Task Order the contractor shall perform all corrective and adaptive maintenance functions for the ECS hardware, custom software, and COTS/OTS software including (SOW 2.3):

- The implementation, test, and delivery of software patches for the correction of Non-conformance reports (NCR).
- Corrective and preventative maintenance of ECS hardware
- Software version maintenance of COTS software products utilized within the ECS
- Hardware revision maintenance of hardware components utilized within the ECS
- Adaptive changes (including changes to custom software) required to accommodate COTS software version updates and hardware revisions
- Ancillary tasks necessary to support above, such as but not limited to interface management, requirements management, configuration management system verification, problem management, program management, quality assurance, documentation, and operations training.

Within the scope of this Task Order the contractor shall implement, test, and deliver corrective, adaptive, and perfective hardware and software changes related to the system and data security of the ECS. (SOW 2.8)

Within the scope of this Task Order the contractor shall perform the following activities:

- System Engineering and Enhancement (SOW 2.4)
- Science Support (SOW 2.5)
- Operations Support (SOW 2.6)
- Performance Assurance (SOW 2.7)
- Property Management (SOW 2.9)

Within the scope of this Task Order the contractor shall perform transition of ECS Maintenance and Development activities. (SOW 2.2)

Within the scope of this Task Order the contractor shall perform Program Management activities in support of the above activities. (SOW 2.1)

Attachment C

Enhancement Task Order Samples

The following tasks are examples of potential future tasks. They are provided here for informational purposes.

Task 1 – Terra and Aqua Capacity Ramp-up

Summary: The contractor shall provide design, procurement, installation, and test of hardware capacity increases to support specified Terra and Aqua mission capacity increases.

Specifics: TBD

Task 2 – Aura (Chem) Mission Support

Summary: The contractor shall support pre-mission integration and test activities in support of the Aura mission.

Specifics: TBD

Task 3 – Aura Capacity Ramp-up

Summary: The contractor shall provide design, procurement, installation, and test of hardware capacities increases to support Aura mission capacity increases.

Specifics: TBD

Attachment D

ECS Science System Sizing and Capacities Summary

This attachment summarizes the currently planned ECS capabilities and key sizing parameters. It should be viewed as an approximation of the system that will be maintained as part of the ECS maintenance contract since additional change requests will be accommodated before the end of the ECS contract.

The EOS Data and Information System (EOSDIS) Core System (ECS) provides capabilities needed to process, store and distribute EOS data to thousands of international scientists and other users. When completed, ECS will be one of the largest geographically distributed information systems in the world, processing and distributing terabytes of information daily and managing archives that will grow into the petabyte range.

The ECS system is deployed at four Distributed Active Archive Centers (DAACs):

- NASA Goddard Space Flight Center in Greenbelt, Maryland,
- NASA Langley Research Center in Hampton, Virginia,
- EROS Data Center (EDC) in Sioux Falls, South Dakota (a U.S. Geological Survey facility), and
- National Snow and Ice Data Center (NSIDC) in Boulder, Colorado (a University of Colorado facility).

In addition to the DAACs, portions of the ECS system are deployed in the ECS System Management Center (SMC), which is co-located with the Goddard DAAC in Greenbelt, Maryland. The SMC supports cross-DAAC functions such as distribution of software releases, management of cross-site databases, and centralized interface management for some external interfaces.

D.1 System Context and Overview

Figure D.1-1 illustrates the context for the ECS science system at the DAACs. The system performs four major functions in this context:

- Ingest of Level 0 data from EDOS, the Landsat-7 Processing System, and the Sage-III MOC; orbit and attitude data from the EOC; and higher level products produced by external processing systems, including ASTER GDS, the Data Assimilation System (DAS), and the Terra, Aqua, CHEM, ICESat, Sage-III and ACRIM Science Investigator-led Processing Systems (SIPS)

- Production of selected Level 1 and higher level products for the EOS instruments on Terra and Aqua
- Management, including archive, of selected data ingested and produced by the system
- Distribution of data ingested and produced by the system to external data processing systems, the EOS science community, and the broader EOS data user community

Key data ingest capabilities include:

- Concurrent ingest from multiple data sources
- Tailoring of data checking, conversion, and preprocessing routines for each data source
- Data source authentication, data transmission checking, and metadata validation

Key data production capabilities include:

- Automated scheduling of algorithm executions based on either data arrival or user requests
- Multiple algorithms may be chained together
- Production rules determine which data is used for input. Example rules include: spatial/temporal selection, optional inputs, alternate inputs
- Product lineage information is collected, archived and available to users
- Extensive tool set for integrating externally developed and maintained science processing software

Key data management capabilities include:

- Rich metadata model that supports mandatory and optional core attributes for all data products, and product-specific attributes, all of which may be used for data search and order
- Ability to add new data types to the system during operations
- Type-specific data services (e.g., subsetting)
- Updates to an existing product's metadata attributes
- Data type versioning
- Access control to data based on data quality
- Storage of the product data can be configured on a data type basis
- Online and near-line storage of data products
- Portions of a data collection may be allocated across multiple storage units (e.g., silos) to improve performance -- allocations may be changed over time to support new access patterns
- Data collections may be replicated to protect against data loss

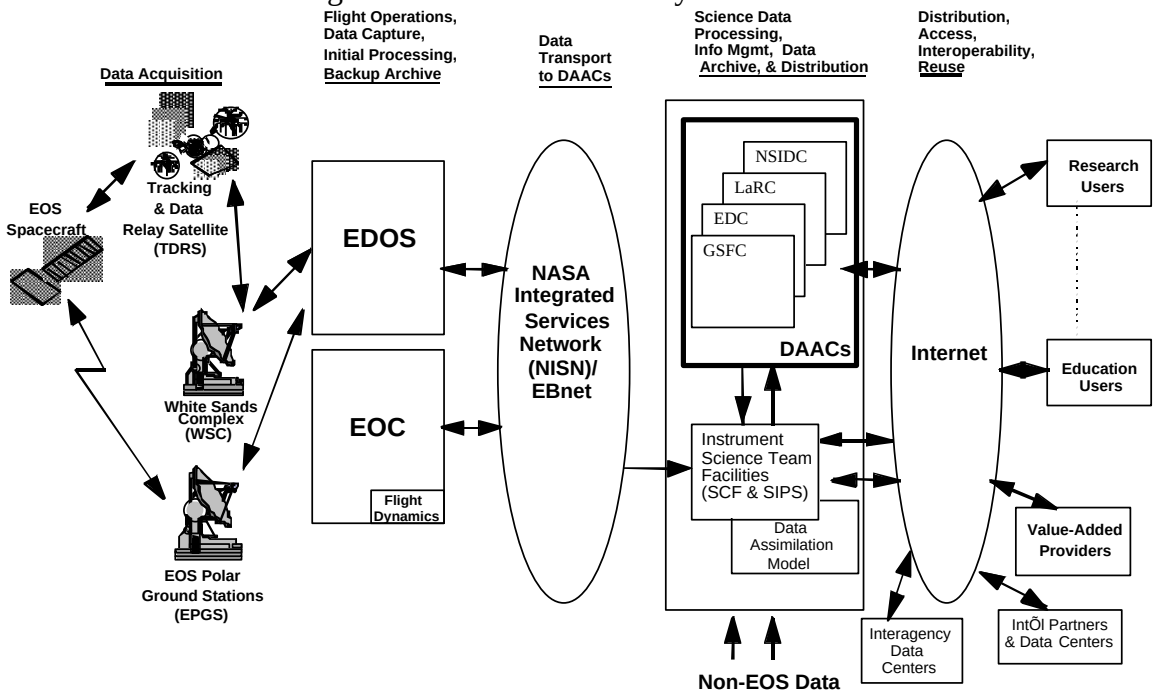
Key data distribution capabilities include:

- Data can be ordered via search and order user interface using core and product-specific data attributes
- System-wide order tracking
- Subscription mechanism provided for automatic delivery of future data
- Electronic and media data delivery, including 8mm and DLT tapes, and CD-ROMs
- Priority-driven data distribution based on user and system priorities
- User-selectable data compression
- Cross-site data transfer to support cross-site production dependencies
- Integration with external data distribution services (e.g., subsetting)
- Bulk distribution of granule metadata to XML-based search engines

In addition to these capabilities, the ECS science system also provides capabilities to aid in system management and in scaling the system to different sized requirements:

- Hardware, software, and network monitoring using HP Openview and Tivoli
- Mode management to permit operations and test activities to be performed concurrently on a single hardware suite
- Key system functions (e.g., processing, archive, data management) can be replicated as needed to support larger system requirements

Figure D.1-1: ECS Science System Context



D.2 System Sizing Parameters

The ECS science system's performance is largely driven by the amount of data that it must ingest, archive and distribute. Tables D.2-1 and D.2-2 summarize the minimum data volumes that the system will have to address by the 12/03 timeframe. The volumes are expected to increase based on evolving instrument team needs.

Site	Ingest (GB/day)	Net Archive Growth (GB/day)	Net Granules Added per day	Net Metadata Added (MB/day)
EDC	1229	438	4232	51
GSFC	691	820	4026	48
LaRC	107	238	1510	18
NSIDC	148	47	1702	20
Total	2175	1543	11470	138

Table D.2-1: ECS Daily Data Management Volumes by 12/03

Site	Cumulative Archive (Tbytes)	Cumulative Granules ('000s)	Cumulative Metadata (GB)
EDC	850	10045	121
GSFC	1485	8866	106
LaRC	348	2893	35
NSIDC	70	2606	31
Total	2753	24410	293

Table D.2-2: ECS Cumulative Data Management Volumes by 12/03

The other major drivers of the system's capacity include the number and size of data processing jobs that the system must support and the number of product data types that it must manage. The currently expected values for these parameters in the 12/03 timeframe are as follows:

- ~ 4,000 Data Processing Requests (or jobs) pre day per site
- ~ 20,000 Mflops of data processing load per day
- ~ 1,300 Earth Science Data Type (ESDT) definitions

As with the data management requirements, these requirements can be expected to evolve before the EMD contract is in place.

D.3 System Components

The ECS Science System is implemented using a combination of custom software, COTS and Government-Off-The-Shelf (GOTS) software, and COTS hardware. The ECS custom software is object-oriented and is implemented primarily in C++ and Java. Table D.3-1 shows how many thousands lines of source code (KSLOC) are expected to support each of the major ECS functions in the 10/02 timeframe. This code is used in part to tightly

integrate some of the COTS software packages used in implementing the system. This is particularly true of the archive, processing, communications (e.g., DCE) and database management (DBMS) support COTS software. The custom software also leverages several commercial and GOTS code libraries. Table D.3-2 lists the major COTS software packages used in the ECS science system. Approximately $20M of COTS software will have been purchased to support ECS by 10/02.

ECS is fielded on high-end Unix servers and integrates commercially available software products for database management, archive access, job scheduling, system management, distributed computing and user access via the web. Table D.3-3 lists the major hardware platforms used in the ECS science system implementation. Approximately $120M of COTS hardware will have been purchased to support ECS by 10/02.

Function	KSLOC (Rel. 6B)
Ingest	93
Archive	239
Processing/Planning	376
Data Access	317
Distribution	68
System Management	75
Infrastructure	123
Total	1291

Table D.3-1 ECS Custom Code Sizing Through Release 6B

Product	Purpose
Code Libraries	
HDF Libraries	Data access
IDL Libraries	Data manipulation
IMSL Libraries	Numeric processing
ODL Libraries	Access ODL constructs
RogueWave Libraries	General class and DBMS access libraries
Data Management	
ACSLS	Archive management
AMASS	Archive management
BDS	High performance file transfer utility for SGI hosts utilizing HiPPI or GB Ethernet
ReelRobot SRI	DLT and 8mm drive management
DB Vision	DBMS monitoring
IQ Report Writer	Report generation
Performance Co-Pilot Sybase Add-on	SGI DBMS performance monitoring
SQR	Report generation
SQS (Spatial Query Server)	Geographic data extension to Sybase

Product	Purpose
Sybase Adaptive Server	Core DBMS services
Sybase Central	Sybase monitoring tool
Sybase Open Client	Sybase interface utility
Sybase Replication Server	Cross-site database replication
System Infrastructure and Management	
DCE Cell Manager	DCE configuration and monitoring tool
DCE Client	DCE clients for HP, Sun and SGI
DCE Security Server	DCE Security Server
Netscape Enterprise Server	Web Server
ssh secure shell	Remote secure system access
TCPWrappers	Security management
Tripwire	Security tracking
AutoSys & Autosys Xpert	Schedule processing jobs
Anlpassword	Password management
BarOne Platinum	Bar code label generation
Crack	Password testing
DDTS	Non-conformance and error tracking
FLEXlm	License Manager for COTS products utilizing FLEXlm
Legato Networker Server	System backup and recovery
OpenView Network Node Manager	Network management and monitoring
Performance Co-Pilot Monitor	SGI performance monitoring
Remedy ARS	Problem and defect tracking
SATAN	Identification of security weaknesses
Tivoli Server	Host management
XRP-II	CM for baselines and inventory

Table D.3-2: Major COTS/GOTS SW Components Deployed in ECS Science System

SYSTEM DESCRIPTION	CPUs	MHz	RAM (MB)	DISK (GB)	RAID (GB)	FUNCTIONS
SGI Origin 2000	4-16	250-300	2048-4096	18-36	360-3060	Science processor, MODIS science processor interface
SGI Challenge XL	2-16	195-250	1024-8192	15-26	360-1080	Science processor, data server access & control processor, file storage management system server, working storage host
SGI Challenge DM	2	150	512-1536	13-31	64-332	Ingest server, science processor
SGI Challenge S	1	150	128	2	32	Algorithm quality assessment processor

SYSTEM DESCRIPTION	CPUs	MHz	RAM (MB)	DISK (GB)	RAID (GB)	FUNCTIONS
HP J210/2	2	120	384	4	100-176	Management subsystem server & backup
Sun 3000	1,2,4	167-333	256-1024	4-54	0-162	Science data server, apps server, interface server, queuing server
Sun 4000	1,2,4	167-333	512-1024	4-8	0-162	Queuing server, DBMS server, distribution server
Sun Ultra 2	1,2	167-200	128-576	4-8	0-196	Planning WS, CM server, management subsystem file server, DBMS server
Sun Sparc 5	1	170	64	4	?	Control workstation for STK Powderhorn
STK Powderhorn 9310	NA	NA	NA	NA	?	Robotic tape library for archive and browse data (D3 and 9840 drives)

Table D.3-3: Major Hardware Components of the ECS Science System

Attachment E

EMD GFE Definitions

This attachment provides a brief description of tools and databases that will be made available to the EMD contractor.

Configuration Management Databases and related software:
Within ECS CM is accomplished by using various tools/systems. The major CM COTS software tools are as follows:

XRP-II: Configuration Management tool for baseline and inventory management. The management systems that utilize XRP-II are Baseline Manager (provides version management for source code, scripts, tools, etc.) and Inventory/Logistics Manager (hardware inventory data, including identifiers, part/serial numbers, vendors, etc.).

ClearCase: Software Configuration Management Tool for automating configuration management of source code, scripts, documentation, and other configuration items. It is a hierarchical library that provides capabilities for simultaneously managing different patches, releases and versions of ECS software. Clear Case is used to create custom code "builds" which are assembled sets of software for release purposes, and keep records of the build's content (files, compiler, and other resources used). Operates in a UNIX operating system environment.

Distributed Defect Tracking System (DDTS): A database system (supplied by Rational Software Corp.) for the creation and tracking of Nonconformance Reports (NCRs) to both the operational and development baselines. Maintains NCR state information, including the nature of the problem, its cause and solution, verification of the solution, as well as the associated versions for each state of each NCR.

Remedy ARS: Problem/Defect tracking tool used at the DAACs to record and track all local problems

ECS Development Facility (EDF): A collection of Sun, SGI and HP enterprise class servers, disk storage subsystems, workstations, media servers, media devices and other peripherals, as well as custom and COTS software used to support development, compilation, unit testing, and integration of new releases of ECS software.

ECS Hardware and software system training: To be specified training developed and presented by the current ECS contractor to the EMD contractor.

Performance Verification Center (PVC): A collection of Sun, SGI and HP enterprise class servers, storage archives, media servers, media devices and other peripherals, as well as custom and COTS software (including test tools) and test data to support end-to-end load testing of new releases of ECS software against future performance requirements.

Property Management data bases and related software: A collection of software and data bases used to support ECS property management and other integrated logistics support (ILS) functions including maintenance management, RMA modeling, software license management, consumables management, replacement parts management, spare parts management, and vendor training management.

Science product generation software: Science product generation software developed and maintained by the Instrument Teams.

Test Tools: A collection of custom tools that are maintained and run on SUN or SGI servers for the purpose generating, cloning, and manipulating data (real or simulated), including Level 0 and higher level products, as well as metadata. These data/tools are required to test and exercise the ECS system and reside in a test data/tools repository that has a web interface and a direct interface into the test facility archive silos. Additionally, there is a GOTS simulator (”SCTGEN”) that is used for Level 0 data generation and manipulation.

Test Data: Test data/metadata, primarily provided from the instrument teams, but in some cases generated by ESDIS. This data is used to clone multiple data granules as needed to support the test and performance verification activities.

Verification and Acceptance Test Center (VATC): A collection of Sun, SGI and HP enterprise class servers, disk storage subsystems, storage archives, workstations, media servers, media devices and other peripherals, as well as custom and COTS software, test tools and test data to support verification and testing of new releases of ECS software against functional requirements.

Verification Data Base (VDB): is a database of tickets that integrates release requirements, verification criteria, development requirements, verification criteria, test procedures and related liens (i.e., NCRs). Contains the official version of the test verification status database for test results, and the traceability from verification criteria to Level 3/ Level 4/ Interface Requirements Document (IRD) requirements. The VDB also provides a series of custom reports that are dynamically generated and accessible via a web interface. The VDB is implemented using Sybase and a Sun web server.